

KEY GROUND WATER GUIDANCE AND REPORTS

U.S. EPA Office of Solid Waste and Emergency Response (OSWER)

The list below includes key OSWER ground water guidances and selected other reports on ground water which are used frequently by Superfund Remedial Project Managers.

A link to an electronic copy of the document is indicated by an underlined web address. EPA employees can order free paper copies of OSWER documents through the EPA Superfund Docket Center at (703) 603-8917. Members of the public can order free paper copies of documents from EPA's National Service Center for Environmental Publications (NSCEP) at <http://www.epa.gov/ncepihom/index.html> or (800) 490-9198. When free copies are not available, NSCEP will refer the requestor to the National Technical Information Service (NTIS), which offers paper documents for a fee at <http://www.ntis.gov/ordering.htm> or (800) 553-NTIS.

ARARs (Applicable or Relevant and Appropriate Requirements)

Guidance:

August 1991. "ARARs Q's & A's: Compliance with New SDWA National Primary Drinking Water Regulations for Organic and Inorganic Chemicals"

OSWER Publication 9234.2-15/FS, NTIS Order Number PB91-921363, 6p.

This fact sheet is one of a series of fact sheets that provide answers to questions that arose in developing applicable or relevant and appropriate requirements (ARARs) policies, training sessions, and in identifying and complying with ARARs at specific sites. This sheet addresses compliance with Safe Drinking Water Act (SDWA) regulations promulgated on January 30, 1991.

July 1991. "ARARs Q's & A's: General Policy, RCRA, CWA, SDWA, Post-ROD Information, and Contingent Waivers"

OSWER Publication EPA/9234.2-01/FS-A, NTIS Order Number PB91-921341CDH, 7p.

This fact sheet is one of a series of fact sheets that provide answers to questions that arose in developing applicable or relevant and appropriate requirements (ARARs) policies, training sessions, and in identifying and complying with ARARs at specific sites. This sheet updates and replaces one which was first issued in May 1989.

July 1990. "ARARs Q's and A's: State Ground-Water Antidegradation Issues"

OSWER Publication EPA/9234.2-11/FS, NTIS Order Number PB91-921311CDH, 9p.

This fact sheet is one of a series of fact sheets that provide answers to questions that arose in developing applicable or relevant and appropriate requirements (ARARs) policies, training

sessions, and in identifying and complying with ARARs at specific sites. This sheet provides guidance on the status of State ground-water antidegradation provisions as potential ARARs for CERCLA ground-water and soil cleanups, and how those provisions relate to EPA's policy of returning usable ground water to its beneficial uses within a time frame that is reasonable, given the particular circumstances of the site.

June 1990. "ARARs Q's & A's: Compliance with Federal Water Quality Criteria"
OSWER Publication EPA/9234.2-09/FS, NTIS Order Number PB90-274267CDH, 8p.

This fact sheet is one of a series of fact sheets that provide answers to questions that arose in developing applicable or relevant and appropriate requirements (ARARs) policies, training sessions, and in identifying and complying with ARARs at specific sites. This sheet addresses compliance with Federal Water Quality Criteria as ARARs. Federal Water Quality Criteria (FWQC) are nonenforceable guidance established by EPA, through the Clean Water Act, for evaluating toxic effects on human health and aquatic organisms. FWQC may be ARARs for a Superfund action when they are relevant and appropriate.

February 1990. "CERCLA Compliance with Other Laws Manual: CERCLA Compliance with the CWA and SDWA"
OSWER Publication EPA/9234.2-06/FS, NTIS Order Number PB90-273806CDH, 10p.

This fact sheet provides a guide to Chapters 3 and 4 of Part I of the "CERCLA Compliance with Other Laws Manual." The fact sheet focusses on CERCLA compliance with the Clean water Act (Chapter 3) and Safe Drinking Water Act (Chapter 4), and discusses other statutes with provisions relevant to surface water or drinking water.

December 27, 1989. "Applicability of Land Disposal Restrictions to RCRA and CERCLA Ground Water Treatment Reinjection, Superfund Management Review: Recommendation No. 26"
OSWER Directive 9234.1-06, NTIS Order Number PB91-921332, 5p.

This memorandum explains EPA's interpretation of Land Disposal Restrictions (LDRs) as potential applicable or (under CERCLA response actions only) relevant and appropriate requirements for groundwater cleanups which involve reinjection. It concludes that LDRs are not applicable to these activities. Instead, RCRA section 3020 applies to reinjection of treated contaminated ground water into Class IV injection wells during CERCLA response actions or RCRA corrective actions. Section 3020 permits reinjection of this water if (1) the injection is a CERCLA response action or RCRA corrective action, (2) the contaminated ground water is treated to substantially reduce hazardous constituents prior to each injection, and (3) the response action or corrective action is sufficient to protect human health and the environment

upon completion. This directive concludes that what is required to “substantially reduce” hazardous constituents prior to each injection should be determined on a case-by-case basis.

August 1988. “CERCLA Compliance with Other Laws Manual. Part I. Interim Final”
OSWER Publication EPA/9234.1-01, NTIS Order Number PB90-272535CDH, 244p.

Section 121(d) of CERCLA requires that on-site remedial actions attain or waive Federal or more stringent State applicable or relevant and appropriate requirements (ARARs) upon completion of the remedial action. The 1990 National Oil and Hazardous Substances Pollution Contingency Plan (NCP) requires compliance with ARARs during remedial actions as well, and during removal actions to the extent practicable. This volume covers potential ARARs of the Resource Conservation and Recovery Act (RCRA), Clean Water Act (CWA), Safe Drinking Water Act (SDWA), Clean Air Act (CAA), and other laws as required by CERCLA.

BROWNFIELDS

Guidance:

November 1995. “Policy Toward Owners of Property Containing Contaminated Aquifers”
OECA Publication (unnumbered), NTIS Order Number PB96-109145, 3p.

This fact sheet by the Office of Enforcement and Compliance Assurance (OECA) summarizes a new EPA policy regarding groundwater contamination. The policy was issued as part of EPA’s Brownfields Economic Redevelopment Initiative. It is intended to help owners of property to which groundwater contamination has migrated or is likely to migrate from a source outside the property. It is based on EPA’s interpretation of CERCLA and existing EPA guidance. Under the policy, EPA will not take action to compel such property owners to perform cleanups or to reimburse the agency for cleanup costs. EPA may also consider *de minimis* settlements with such owners if they are threatened with law suits by third parties.

IN-SITU TREATMENT/INNOVATIVE TECHNOLOGIES

For technical resources concerning in-situ and innovative technologies for ground water cleanup, see the following web sites:

CLU-IN: EPA’s Hazardous Waste Cleanup Information
Available on-line at <http://www.clu-in.org>

This web site provides a comprehensive source of on-line and downloadable information about site remediation and field analytical technologies, including those pertaining to groundwater, developed by EPA's Technology Innovation Office. In addition, users may subscribe on-line to a list server that e-mails subscribers monthly announcements of recent documents, training, and conferences related to site assessment and remediation. The website is updated daily with information of value to technology users, developers, and providers. Also available from CLU-IN is <http://clu-in.org/tsp/gwforum.htm>, which contains publications on various groundwater issues developed by a network of EPA Remedial Project Managers, Corrective Action Staff, and On-Scene Coordinators together with EPA's research scientists.

REACH IT: EPA's Remediation and Characterization Innovative Technologies
Available on-line at <http://www.epareachit.org>.

This web site is an on-line database on the availability, performance, and cost of remediation and characterization technologies, developed by EPA's Technology Innovation Office. The database contains EPA data on the application of in situ groundwater treatment technologies at over 80 specific sites. It also provides information on over 60 vendors offering in situ techniques to remediate groundwater, and 32 vendors with in situ site characterization methods for groundwater, LNAPL, or DNAPL.

FRTR: Federal Remediation Technologies Roundtable
Available on-line at <http://www.ftrr.gov>.

This web site was developed by a consortium of EPA and 6 other federal agencies to improve the availability of innovative technologies. It contains three sources of information on groundwater characterization and cleanup technologies. **Remediation Case Studies** is a searchable collection of 140 case studies of sites using cleanup technologies, 53 of which relate to groundwater remediation. **Remediation Technologies Screening Matrix and Reference Guide, Third Edition**, is a comprehensive guide to site cleanup technologies. Users can compare the applicability of multiple technologies for a specific contaminant and media, including groundwater. Its reference list of technology information sources includes more than 1200 reports, many with links to electronic copies. Also on this website is the **Field Sampling and Analysis Technologies Matrix and Reference Guide**, which provides comparative screening information on analytical and sampling technologies.

GWRTAC: Ground Water Remediation Technology Center
Available on-line at <http://www.gwrtac.org>.

GWRTAC is a private organization operated by the Concurrent Technologies Corporation in association with the University of Pittsburgh and funded by a Cooperative Agreement with EPA's Technology Innovation Office. The Center collects, analyzes, and prepares reports on

in situ ground water remediation technologies. This web site contains definitions and dozens of reports on in-situ ground water cleanup technologies. Reports are available on the following technologies: in situ physical/chemical treatment (air sparging, horizontal wells, hydraulic and pneumatic fracturing, in-situ flushing, in-situ stabilization/solidification, in-well vapor stripping, surfactants/cosolvents, thermal enhancements, treatment walls); ex situ physical/chemical treatment (uv/oxidation); biological treatment (bioslurping, intrinsic bioremediation, phytoremediation); and electrokinetics.

SITE: EPA's Superfund Innovative Technology Evaluation Program

Available on-line at <http://www.epa.gov/ORD/SITE/profiles.html>.

This web site contains the SITE Program Technology Profiles, 9th Edition (EPA-540-R-97-502), which describes each of the 190 cleanup and 28 measurement/monitoring technologies in the SITE program. The website also contains some of the reports documenting EPA's evaluations of innovative cleanup technologies. Under the SITE program, EPA enters into agreements with technology developers to further develop and/or demonstrate their technologies with support from EPA. EPA collects and disseminates engineering, performance, and cost data on the technologies.

SRIC: EPA's Subsurface Remediation Information Center

Available on-line at <http://www.epa.gov/ada/sric.html>.

This Information Center is a component of the Technology Support Center located at EPA's National Risk Management Research Laboratory in Ada, Oklahoma. The web site contains numerous documents, including a comprehensive bibliography, related to ground water protection and cleanup.

MONITORED NATURAL ATTENUATION

Guidance:

April 1999. "Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites"

Final OSWER Directive 9200.4-17P, NTIS Order Number PB99 963 315, 39p.

Available on-line from OSWER at <http://www.epa.gov/swerust1/directiv/d9200417.htm> in PDF format.

This directive clarifies EPA's policy regarding the use of monitored natural attenuation (MNA) for the remediation of contaminated soil and ground water. It defines the term "monitored natural attenuation" and explains that EPA considers it a remedy, not a "no action" alternative.

The directive outlines potential advantages and disadvantages of this remedy, under what conditions it should be selected, the type of site most suitable for this remedy choice, the site data required to support the decision, performance monitoring considerations, and the use of contingency remedies. The directive also has a lengthy bibliography, including EPA web sites with information on monitored natural attenuation.

Other Reports:

October 1998. "Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water"

National Risk Management Research Laboratory (NRMRL), Ada, Oklahoma, Publication EPA/600/R-98/128, NTIS Order Number PB99-130023, 214p.

Available on-line from NRMRL at <ftp://ftp.epa.gov/pub/ada/reports/protocol.pdf>.

This protocol provides guidance for environmental managers on the steps that must be taken to understand the rate and extent to which natural processes are reducing contaminant concentrations at sites that are contaminated by chlorinated solvents. The document identifies parameters that are useful in the evaluation of natural attenuation of chlorinated solvents (chlorinated aliphatic hydrocarbons and/or fuel hydrocarbons) and provides recommendations to analyze and interpret the data collected from the site characterization process. It also provides suggestions for integrating monitored natural attenuation (MNA) into an integrated approach to remediation that also includes an active remedy. It includes a useful list of definitions of terms related to the topic. It is a technical, not a policy, document. Data gathered using this protocol can be used to evaluate whether MNA by itself or in conjunction with other technologies is sufficient to achieve site remedial objectives, and to compare the relative effectiveness of MNA and other remedial methods. This protocol is the result of a collaborative field and laboratory research effort involving researchers from EPA's Office of Research and Development, the U.S. Air Force, and the U.S. Geological Survey.

NON-AQUEOUS PHASE LIQUIDS (NAPLS)

Guidance:

July 31, 1995. "Superfund Groundwater RODs: Implementing Change This Fiscal Year"

OSWER Memorandum 9335.5-03P, EPA-540-F-99-005, NTIS Order Number PB99-963220, 2p.

This memo from Elliott Laws, EPA Assistant Administrator for Solid Waste and Emergency Response, to the EPA Regional Administrators discusses the importance of consistent national implementation of policies concerning Records of Decision (RODs) for sites with ground water contamination. It emphasizes that OSWER expects that Technical Impracticability (TI) waivers

will generally be appropriate for sites with contaminated ground water where restoration to drinking water standards is technically impracticable, for example, sites with DNAPLs. The memo states that “Beginning immediately, RODs addressing DNAPL contamination that do not follow the policy in favor of TI waivers at such sites must include a written justification for that departure from this policy.”

September 1993. “Guidance for Evaluating Technical Impracticability of Ground-Water Restoration” OSWER Directive 9234.2-25, EPA/540-R-93-080, NTIS Order Number PB93-963507, 26p. Available on-line from OSWER at <http://www.epa.gov/superfund/resources/gwdocs/techimp.pdf>.

This interim final guidance clarifies how EPA will determine whether ground water restoration at Superfund and RCRA sites is technically impracticable and if so, what alternative measures must be undertaken to ensure that a final remedy is protective. Topics include the types of technical data needed, the criteria for decisions, the types of documentation needed, and alternative remedial strategies for sites with dense non-aqueous phase liquids (DNAPLs).

May 27, 1992. “Considerations in Ground-Water Remediation at Superfund Sites and RCRA Facilities -- Update” OSWER Directive 9283.1-06, NTIS Order Number PB92-963358, 13p.

This directive clarifies and expands OSWER’s 1989 directive “Considerations in Ground-Water Remediation at Superfund Sites” (see “remedy selection”), especially with regard to non-aqueous phase liquid (NAPL) contaminants. The directive recommends: that the likelihood of NAPL contamination, especially dense NAPLs (DNAPLs), should be evaluated as early as possible; where NAPLs are likely, the potential nature and extent of contamination should be characterized to determine appropriate remedial actions; further contamination (dissolved or NAPL) migration should be minimized by using early response actions; early actions should be coordinated with later actions in a phased approach; and ground water cleanup actions should be designed to include careful monitoring and provisions for modifying them over time to improve their effectiveness. For sites where it can be demonstrated to EPA that achieving cleanup standards is technically impracticable, EPA may issue a waiver for Superfund sites or modify the permit or enforcement order for RCRA facilities. For these cases, EPA will determine alternative remedial objectives that protect human health and the environment.

See also:

October 1996. “Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance” OSWER Directive 9283.1-12, NTIS Order Number PB96-963508, 73p. Available on-line from OSWER at <http://www.epa.gov/superfund/resources/gwgguide/gwfinal.pdf>

This guidance outlines the “phased approach” strategy for addressing contaminated ground water. The strategy integrates the site characterization, early actions, remedy selection, design, implementation, and performance monitoring phases. The strategy emphasizes ways to select achievable remedial objectives and ways to optimize the selected remedy so that it is more effective, less costly, and takes less time. The guidance also identifies presumptive technologies for treatment of extracted ground water, which are to be used to streamline the Feasibility Study for sites which evaluate pump and treat remedies.

Other Reports:

July 1995. “Ground Water Issue: Light Nonaqueous Phase Liquids”

ORD and OSWER joint publication EPA/540/S-95/500, NTIS Order Number PB95-267738, 28p.

This issue paper from the Technical Support Project discusses light nonaqueous phase liquids (LNAPLs), or NAPL which has a density less than water. The paper summarizes LNAPL fate and transport and remediation technologies of use for LNAPL recovery. It includes a table of the physical properties of chemical compounds most prevalent at Superfund sites which have a specific gravity less than water.

September 1994. "DNAPL Site Characterization"

OSWER Publication 9355.4-16FS, EPA/540/F-94/049, NTIS Order Number PB94-963317, 12p.

Available on-line from OSWER at <http://www.epa.gov/superfund/resources/gwdocs/dnapl.pdf>.

This fact sheet provides a strategy for the investigation of dense non-aqueous phase liquids (DNAPLs) at sites, including a flow chart of suggested activities and suggestions on site conceptualization and objectives. It also summarizes noninvasive and invasive field methods for DNAPL characterization and provides a table summarizing how one might determine, infer or suspect DNAPL presence at a site.

September 1993. “Evaluation of the Likelihood of DNAPL Presence at NPL Sites, National Results”

OSWER Publication 9355.4-13, EPA/540-R-93-073, NTIS Order Number PB93-963343, 68p.

This publication presents the results of a survey of 712 National Priority List (NPL) sites to estimate the proportion of NPL sites where dense non-aqueous phase liquids (DNAPLs) may be present. The project also assessed the usefulness of various indirect indicators of DNAPL presence associated with historical site information and ground water contaminant information.

January 1992. "Estimating Potential for Occurrence of DNAPL at Superfund Sites,"

OSWER Publication 9355.4-07FS, NTIS Order Number PB92-963338CDH, 9p.

Available on-line from OSWER at <http://www.epa.gov/superfund/resources/gwdocs/estdnapl.pdf>.

The presence of DNAPL in soils and aquifers can control the ultimate success or failure of remediation at a site, but because of the complex nature of DNAPL transport and fate, it may often be undetected by direct methods. This fact sheet provides a guide for estimating the potential for the presence of dense non-aqueous phase liquids (DNAPLs) at a site based on historical site use information and site characterization data. It summarizes the definition of DNAPL and presents five conceptual models for its release and presence at sites. It includes a series of flow charts for deciding whether a site has a high, moderate, or low potential for containing DNAPL. It also includes step by step worksheets for calculating effective solubility of single-component DNAPL and for assessing the likelihood of DNAPL presence based on organic concentrations in soil samples; and a glossary of terms related to DNAPLs.

March 1991. "Ground Water Issue: Dense Nonaqueous Liquids"

ORD and OSWER joint Publication EPA/540/4-91-002, NTIS Order Number PB91-195974, 21p.

This issue paper of the Technology Support Project provides an overview from a conceptual fate and transport point of view, of DNAPL phase distribution, monitoring, site characterization, remediation, and modeling. It includes a table of the physical properties of chemical compounds most prevalent at Superfund sites which have a specific gravity greater than water.

See also: technical impracticability; remedy selection/RODs.

PERFORMANCE EVALUATION / CLOSE-OUT

June 1994. "Methods for Monitoring Pump-and-Treat Performance"

Office of Research and Development Publication EPA/600/R-94/123, NTIS Order Number PB95-125456, 102p.

This publication provides guidance for monitoring the effectiveness and efficiency of pump-and-treat remediation systems, with emphasis on the "pump" part of the technology rather than chemical enhancements. The report includes sections on monitoring hydraulic containment, monitoring ground water restoration, evaluating restoration success/closure, a case study, and references. It includes performance criteria, monitoring objectives, and protocols for evaluating effectiveness of containment and restoration systems.

July 1992. "Methods for Evaluating attainment of cleanup standards, Vol. 2: Groundwater"

Office of Policy, Planning, and Evaluation Publication EPA/230-R-92-014, NTIS Order Number PB94-138815, 234p.

This guidance document was written specifically for Superfund sites and provides sampling and analysis methods for evaluating whether ground water remediation has met pre-established

cleanup standards for one or more chemical contaminants. It includes suggestions for writing measureable and enforceable cleanup objectives and sampling and analysis plans, and discussions of different statistical methods which are useful during and after remediation to address the uncertainty of whether a site has reached steady state and met a cleanup standard. The document also includes sample statistical calculations and worksheets and an extensive bibliography.

January 1992. "General Methods for Remedial Operation Performance Evaluations"

Robert S. Kerr Environmental Research Laboratory (now National Risk Management Research Laboratory--NRMRL), Ada, Oklahoma, Publication EPA/600/R-92/002, NTIS Order Number PB92-166842, 45p.

Available on-line from NRMRL at <ftp://ftp.epa.gov/pub/ada/reports/genmeth.pdf>.

This research report explains technical considerations and principles necessary to evaluate the performance of ground water contamination remediations at hazardous waste sites. It presents generic principles for formulating site-specific evaluation strategies. (It is not a "cookbook".) It emphasizes the development of monitoring strategies which ensure that sampling locations and schedules are meaningful, and to the use of data reduction, presentation and interpretation techniques.

PHASED APPROACH

Guidance:

October 1996. "Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance"

OSWER Directive 9283.1-12, NTIS Order Number PB96-963508, 73p.

Available on-line from OSWER at <http://www.epa.gov/superfund/resources/gwguide/>.

This guidance outlines the "phased approach" strategy for addressing contaminated ground water. The strategy integrates the site characterization, early actions, remedy selection, design, implementation, and performance monitoring phases. The strategy emphasizes ways to select achievable remedial objectives and ways to optimize the selected remedy so that it is more effective, less costly, and takes less time. The guidance also identifies presumptive technologies for treatment of extracted ground water, which are to be used to streamline the Feasibility Study for sites which evaluate pump and treat remedies.

May 27, 1992. "Considerations in Ground-Water Remediation at Superfund Sites and RCRA Facilities - Update"

OSWER Directive 9283.1-06, NTIS Order Number PB92-963358, 13p.

This directive clarifies and expands OSWER's general policy concerning remediation of contaminated ground water, especially with regard to nonaqueous phase liquid (NAPLs) contaminants. It summarizes actions that should be included at sites with NAPL involving site investigation, early or interim actions, and remedy implementation, including findings of Technical Impracticability.

October 10, 1990. "Suggested ROD Language for Various Ground Water Remediation Options" OSWER Directive 9283.1-03, NTIS Order Number PB91-921325, 9p.

This directive provides guidance for Superfund Records of Decision (RODs) concerning ground water. The guidance recommends remedies be defined as final actions where there is little uncertainty that the remedy will be able to achieve remediation goals; contingency measures or goals where there is high to moderate uncertainty, potential ARARs waivers, or a potential containment goal; and interim actions where there is moderate to substantial uncertainty or early action containment measures. The guidance includes sample ROD language for all options.

PUMP & TREAT REMEDIATION

Guidance:

October 1996. "Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance" OSWER Directive 9283.1-12, NTIS Order Number PB96-963508, 73p.
Available on-line from OSWER at <http://www.epa.gov/superfund/resources/gwguide/>.

This guidance outlines the "phased approach" strategy for addressing contaminated ground water. The strategy integrates the site characterization, early actions, remedy selection, design, implementation, and performance monitoring phases. The strategy emphasizes ways to select achievable remedial objectives and ways to optimize the selected remedy so that it is more effective, less costly, and takes less time. The guidance also identifies presumptive technologies for treatment of extracted ground water, which are to be used to streamline the Feasibility Study for sites which evaluate pump and treat remedies.

March 1991. "Guide to Discharging CERCLA Aqueous Wastes to Publicly Owned Treatment Works (POTWs)" OSWER Publication 9330.2-13FS, NTIS Order Number PB91-921364, 5p.

This guide provides a quick reference to the statutory, policy, administrative, and technical factors involved in discharging aqueous wastes generated during Superfund response actions to a POTW. It also provides references for more extensive guidance on this topic.

Other Reports:

September 1997. “Design Guidelines for Conventional Pump-and-Treat Systems”
ORD and OSWER joint Publication EPA/540/S-97/504, EPA-68-C4-0031, NTIS Order Number PB98-115389INZ, 44p.

Available on-line from the National Environmental Publications Information Service at
<http://www.epa.gov/clariton/clhtml> in TIF format.

These technical guidelines discuss pump and treat (P&T) remediation strategies (including hydraulic containment, restoration, and mixed objectives); site characterization considerations for P&T design; capture zone analysis for P&T design; extraction/ injection scheme design; components of a P&T system; selection of treatment technologies; and performance monitoring.

July 1996. “Pump-and-Treat Ground-Water Remediation: A Guide for Decision Makers and Practitioners”

Office of Research and Development Publication EPA/625/R-95/005, NTIS Order Number PB97-154009, 74p.

Available on-line from ORD at <http://www.epa.gov/ORD/WebPubs/pumptreat> in PDF format and from NSCEP at <http://www.epa.gov/clariton/clhtml> in TIF format.

This report addresses: when pump-and-treat is appropriate and how to apply it in a “smart” fashion; how to anticipate tailing and rebound; how to make hydraulic containment more effective; performance measurement and optimization; and when to use variations and alternatives to pump-and-treat. The report includes discussions of both traditional and enhanced or innovative uses of pump and treat, and combinations of pump-and-treat with in-situ methods. It recognizes that total plume restoration through pump-and-treat will be possible at a small number of sites, but parts of plumes can be totally restored at many sites using this method.

January 1992. “Ground Water Issue: Chemical Enhancements to Pump-and-Treat Remediation”
OSWER Publication EPA/540/S-92/001, NTIS Order Number PB92-180074CDH, 20p.

This document explores the use of chemical enhancements to improve ground water remediation efficiencies using pump-and-treat technologies, and points out arenas of contamination where such techniques are not practical, in an attempt to address the protracted period of time to make significant reductions in contaminants at many ground water treatment sites.

February 1992. "Evaluation of Ground-Water Extraction Remedies: Phase II"
OSWER Publication 9355.4-05, Vol. 1: NTIS Order Number PB92-963346, 27p.; Vol. 2: NTIS
Order Number PB92-963347, 450p.

This report is the second phase of a study to evaluate the effectiveness of ground water extraction systems being used to remediate contaminated aquifers at hazardous waste sites. "Volume 1: Summary Report" contains an executive summary and chapters which discuss the purpose, methodologies, and conclusion of the project. It also summarizes the conclusions from Phase I of the project. The second phase of the study puts special emphasis on nonaqueous phase liquids (NAPLs). "Volume 2: Case Studies" contains the individual analyses of each of the 24 sites associated with the project.

March 1990. "Basics of Pump-and-Treat Ground-Water Remediation Technology"
Office of Research and Development Publication EPA/600/8-90/003, NTIS Order Number PB90-274549, 55p.

This report provides basic information on how to use available hydrogeological and chemical data to determine when, where, and how pump-and-treat technology can be used successfully to contain and/or remediate plumes. It also discusses ways to estimate cleanup times and addresses practical limitations of pump-and-treat. The report emphasizes the "pump" part of "pump-and-treat", including estimating discharge rates and concentration loadings. Treatment strategies and policy questions are not discussed. The report assumes some basic familiarity with hydrogeological concepts. It includes a section on operation and maintenance of pump-and-treat systems and a glossary of terms.

See also:

June 1994. "Methods for Monitoring Pump-and-Treat Performance"
(described under "Performance Evaluation")

REMEDY SELECTION / RODS

Guidance:

Draft. "Guidance on Preparing Superfund Remedial Decision Documents"
Publication expected 1999, 185p.
Draft available on-line for EPA employees only at <http://intranet.epa.gov/oerrinet>.

This updated guidance on writing Records of Decision (RODs), Explanations of Significant Difference (ESDs) and ROD amendments includes very good sections on documenting all

types of ground water remedy decisions and technical impracticability waivers, including sample language.

August 1997. “Rules of Thumb for Superfund Remedy Selection”

OSWER Publication 9355.0-69, EPA 540-R-97-013, NTIS Order Number PB97-963301, 23p.

Available on-line from OSWER at <http://www.epa.gov/superfund/resources/index.htm> in PDF format.

This guidance describes key principles and expectations, interspersed with “best practices” based on program experience, that should be consulted during the Superfund remedy selection process. Three major policy areas are covered: risk; remedial alternatives; and ground water. The guidance summarizes key elements of other guidance documents in these areas and provides citations for other EPA guidances an RPM may need to consult for more detailed information.

September 27, 1996. “Superfund Reforms: Updating Remedy Decisions,”

OSWER Memorandum 9200.0-22., EPA540/F-96/026, NTIS Order Number PB96-963252, 9p.

Available on-line from OSWER at <http://www.epa.gov/superfund/resources/presump/index.htm> in PDF format.

This memo explains the purpose of the reform, the types of remedy updates anticipated, and the process for updating remedies. It includes specific detail about how the reform relates to ground water remedies, especially with regard to remedy updates which 1. Change the remediation technology, 2. Reconsider remedial objectives, or 3. Reduce monitoring data needs.

November 1991. “A Guide to Principal Threat and Low Level Threat Wastes”

OSWER Publication 9380.3-06FS, NTIS Order Number PB92-963345, 3p. Available on-line from

OSWER at <http://www.epa.gov/superfund/resources/presump/index.htm> in PDF format.

This guidance explains considerations that should be taken into account in categorizing waste for which treatment or containment generally will be suitable and provides definitions, examples, and ROD documentation requirements related to waste that constitute a principal or low level threat. It explains that the concept of principal threat is to be applied when characterizing source material and that contaminated ground water is not generally considered to be a source material, although non-aqueous phase liquids (NAPLs) may be viewed as source materials.

April 1989. “A Guide on Remedial Actions for Contaminated Ground Water”

OSWER Directive 9283.1-1FS, NTIS Order Number PB90-2725676CDH, 6p.

This fact sheet summarizes key issues in the development, evaluation, and selection of ground water remedial actions at Superfund sites. It provides a short summary of CERCLA

requirements, project planning, remedial action objectives, types of response actions, evaluating performance, and a multiple source strategy. For more detail on this topic, see December 1988, “Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites”, below. Use of either document should be augmented by more recent guidance.

December 1988. “Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites”

OSWER Directive 9283.1-2, EPA/540/G-88/003, NTIS Order Number PB89-184618, 67p.

This guidance summarizes policy issues and the decision-making approach to developing, evaluating, selecting, and implementing ground water remedial actions at Superfund sites. It should be supplemented by reference to more recent guidance on specific topics, but is still a useful overview. It includes practical appendices on: a case study, multiple source plume issues, interim action RODs for ground water, and equations for estimating restoration time-frame.

See also:

October 1996. “Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance” (described under “Phased Approach”)

REMOVAL ACTIONS

Guidance:

November 10, 1998. “Numeric Removal Action Levels for Contaminated Drinking Water Sites”
OSWER Memorandum 9360.1-02B-P, EPA-540-F99-004, NTIS Order Number PB99-963405, 18p.

This memo transmits the most recent tables of Removal Action Levels (RALs), dated April 1997. The tables are provided as a convenience to response managers and are intended to be used as one factor in determining whether to provide alternate water supplies under Superfund removal authority. For substances not listed in the RAL table, response managers should refer to the methodology outlined in OSWER Directive 9360.1-02, dated October 1993, to derive a number.

October 25, 1993. “Final Guidance on Numeric Removal Action Levels for Contaminated Drinking Water Sites”

OSWER Directive 9360.1-02, NTIS Order Number PB95-963-419, 26p.

This Directive includes the final Office of Emergency and Remedial Response methodology and guidance on calculation of numeric removal action levels (RALs), to assist Superfund personnel in deciding whether to provide alternate sources of drinking water to populations adversely affected by releases of hazardous substances into the environment. The RAL tables attached to this guidance were updated in September 1995, March 1995, and most recently in April 1997 (retransmitted November 1998). The tables are a convenience only; RALs for additional constituents may be derived using the methodology provided in this guidance.

February 1988. "Guidance Document for Providing Alternate Water Supplies"
OSWER Directive 9355.3-03, EPA/540/G-87/006, NTIS Order Number PB89-167969,
63p.

This guidance was written to help response managers plan and implement alternate water supplies at uncontrolled hazardous waste sites where the action can be done under a Non-Time Critical Removal Action or an Operable Unit (or "early") Remedial Action. It does not address alternate water supplies implemented under Time-Critical Removal Actions or as a normal part of a final Remedial Action. The document provides guidance on determining if an alternate water supply is needed, and if needed, on selection and implementation of alternate water supplies. It includes provision of new supplies and treatment or redistribution of existing supplies. Appendix C on EPA Standards and Appendix D on Removal Action Levels have been superseded by more recent standards and guidance.

SITE ASSESSMENT / SITE CHARACTERIZATION

Guidance:

November 1992. "Hazard Ranking System Guidance Manual"
OSWER Publication 9345.1-07, EPA 540-R-92-026, NTIS Order Number PB92-963377, 524p.

This guidance manual provides general and technical guidance for individuals involved in determining Hazard Ranking System (HRS) scores and preparing HRS scoring packages for proposal of sites to the National Priority List. Although it is targeted primarily to HRS scorers and package preparers, others involved in the site assessment process may find parts of the document useful. It presents strategies and specific guidance for scoring the ground water pathway in Chapter 7.

Other reports:

April 1996. "Ground Water Issue: Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures"

OSWER Publication EPA/540/S-95/504, NTIS Order Number PB97-118822, 12p.

This report provides background information on the development of low-flow sampling procedures and its application under a variety of hydrogeologic settings. It is intended to support the production of standard operating procedures for use by EPA Regional personnel and other environmental professionals engaged in ground water sampling.

October 1990. "Subsurface Contamination Reference Guide"

OSWER Publication EPA/540/2-90/011, 11a, and 11b, NTIS Order Number PB91-921292, 13p. (Includes tables on 2 oversize sheets with publication numbers "11a" and "11b.")

The guide includes 3 large tables of contaminants commonly found at Superfund sites, their physical and chemical properties, and applicable technologies for in-situ treatment. The guide was developed to provide a source of information on fate and transport properties for a variety of contaminants commonly found in ground water at Superfund sites. The information may help to focus site investigation efforts and identify early-on potential remediation strategies.

TECHNICAL IMPRACTICABILITY

Guidance:

January 19, 1995. "Consistent Implementation of the FY 1993 Guidance on Technical Impracticability of Ground-Water Restoration at Superfund Sites"

OSWER Directive 9200.4-14, NTIS Order Number PB95-963221, 7p.

This memorandum promotes national consistency in implementation of the 1993 guidance and clarifies the role of EPA Headquarters in Technical Impracticability decisions. It clarifies that these decisions should be made as soon in the Superfund process as sufficient information is available, e.g., either at the time of the ROD or post-ROD.

September 1993. "Guidance for Evaluating Technical Impracticability of Ground-Water Restoration"

OSWER Directive 9234.2-25, EPA-540-R-93-080, NTIS Order Number PB93-963507, 26p.

Available on-line from OSWER at <http://www.epa.gov/superfund/resources/index.htm> in PDF format.

This interim final guidance clarifies how EPA will determine whether ground water restoration at Superfund and RCRA sites is technically impracticable and if so, what alternative measures must be undertaken to ensure that a final remedy is protective. Topics include the types of technical data needed, the criteria for decisions, the types of documentation needed, and alternative remedial strategies for sites with dense non-aqueous phase liquids (DNAPLs).

See also:

August 1997. "Rules of Thumb for Superfund Remedy Selection" (described under "Remedy Selection")

October 1996. "Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance" (described under "Phased Approach")

July 31, 1995. "Superfund Groundwater RODs: Implementing Change This Fiscal Year" (described under "NAPL")

USE DETERMINATIONS**Guidance:**

April 4, 1997. "The Role of CSGWPPs in EPA Remediation Programs"
OSWER Directive 9283.1-09, NTIS Order Number PB95-963325, 12p.
Available on-line from OSWER at <http://www.epa.gov/superfund/resources/csgwpp/roledesc.htm> in PDF format.

This directive establishes and explains the policy that EPA remediation programs generally should defer to State determinations of current and future ground water uses when based on an EPA-endorsed Comprehensive State Ground Water Protection Program (CSGWPP). This directive also provides background information on CSGWPPs.

December 1992. "Final Comprehensive State Ground Water Protection Program Guidance,"
U.S. EPA Office of the Administrator Publication EPA-100-R-93-001, NTIS Order Number PB93-163087, 134p.

This guidance provides guidance to States on preparing Comprehensive State Ground Water Protection Programs with the goal of coordinating ground water protection across programs and providing additional flexibility to States in directing their ground water activities. The guidance defines EPA's three-tiered hierarchy of preferred ground water protection objectives (prevention wherever possible; prevention based on vulnerability, use and value; remediation based on relative use and value.) The guidance also outlines State linkages to EPA and other Federal programs which relate to ground water.

November, 1986. "Guidelines for Ground-Water Classification Under the [1984] EPA Ground-Water Protection Strategy, Final Draft"

Office of Ground-Water Protection Publication EPA/440/6-86-007, NTIS Order Number PB88-229067, 135p. plus appendices. (Executive Summary 10 p.)

Executive summary available on-line from OSWER at

<http://www.epa.gov/superfund/resources/gwdocs/grndh2o.htm> in PDF format.

These Final Draft guidelines further define the concepts and key terms related to the classification system outlined in the 1984 Ground Water Protection Strategy, and describe procedures and information needs for classifying ground water using this approach. Although the guidelines were not finalized, they are still in current use, as modified by the more recent CSGWPP guidances.

Other Reports:

July 1991. "Protecting the Nation's Ground Water: EPA's Strategy for the 1990's, The Final Report of the EPA Ground-Water Task Force"

U.S. EPA Office of the Administrator Publication EPA/21Z-1020, NTIS Order Number PB92-224765, 84p.

This report provides Agency policy and implementation principles for EPA's ground water-related programs. It lays out EPA's ground water protection principles, the Federal/State relationship, EPA's approach to implementation, Agency policy on use of quality standards in prevention and remediation, ground water data management recommendations, and an Office of Research and Development Ground Water Research Plan.

August 1984. "Ground Water Protection Strategy"

Office of Ground-Water Protection Publication(unnumbered), NTIS Order Number PB88-112107, 69p.

Available on-line from OSWER at <http://www.epa.gov/superfund/resources/gwdocs/strategy.pdf> in PDF format.

This document summarizes the nature and extent of ground water contamination in the United States, outlines the responsibilities of State, local and Federal government in ground water protection, and lays out EPA's strategy to fulfill its role by strengthening State programs, addressing current ground water problems, and creating EPA policies and internal organizations for ground water protection. This includes the policy that ground water protection should consider the highest beneficial use for which it has significant value or potential, and defines three classes of ground water based on value and vulnerability to contamination: Class I, II and III.

YEAR 2000

See EPA's Year 2000 web site at <http://www.epa.gov/year2000> for an explanation of Y2K issues and resources which may be useful in ensuring continued integrity and security of ground water remedies.